Recent Earthquakes Briefing: Lessons for the PNW

PRESENTED TO:

Seattle City Council
July 18, 2011
Seattle, Washington

PRESENTED BY

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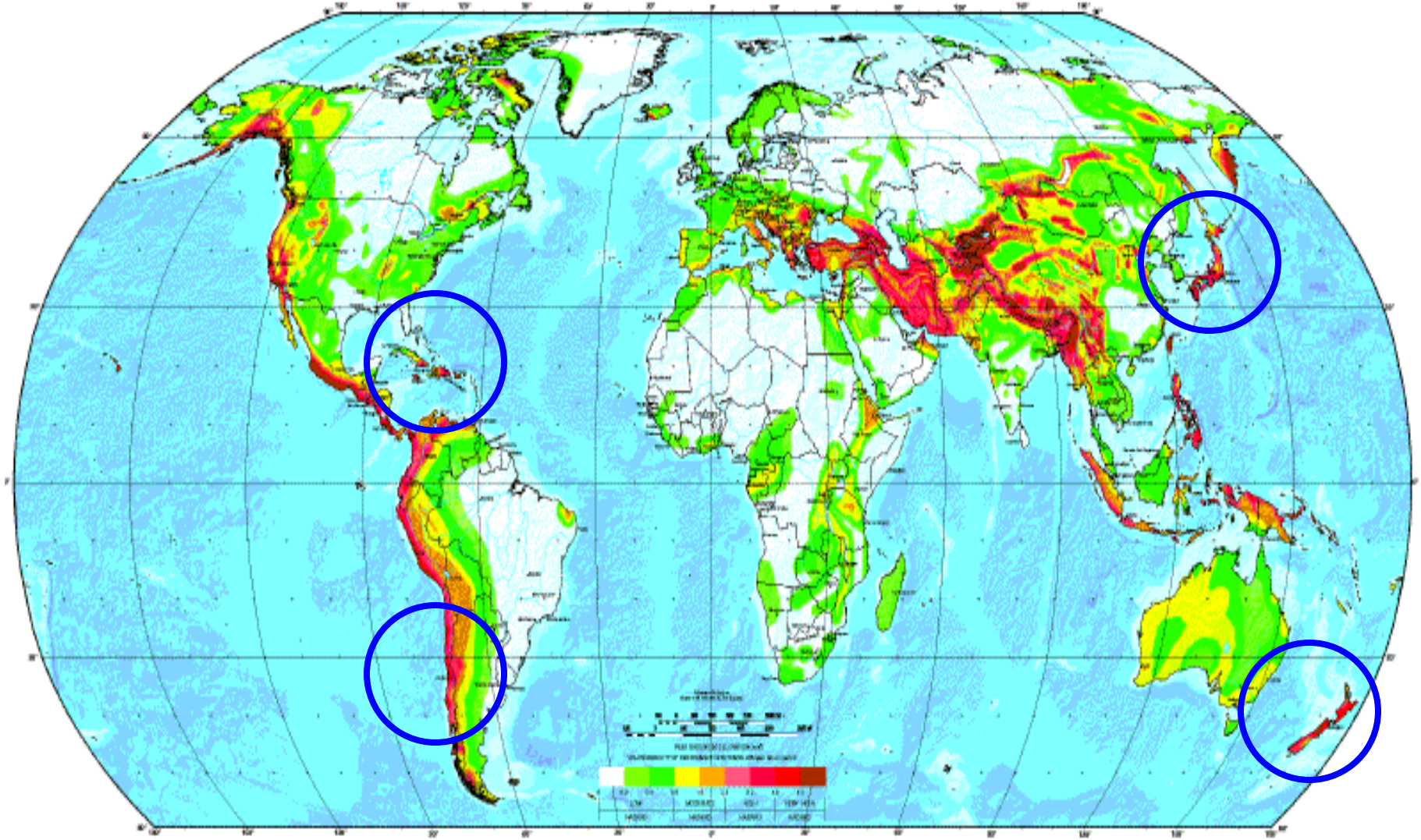
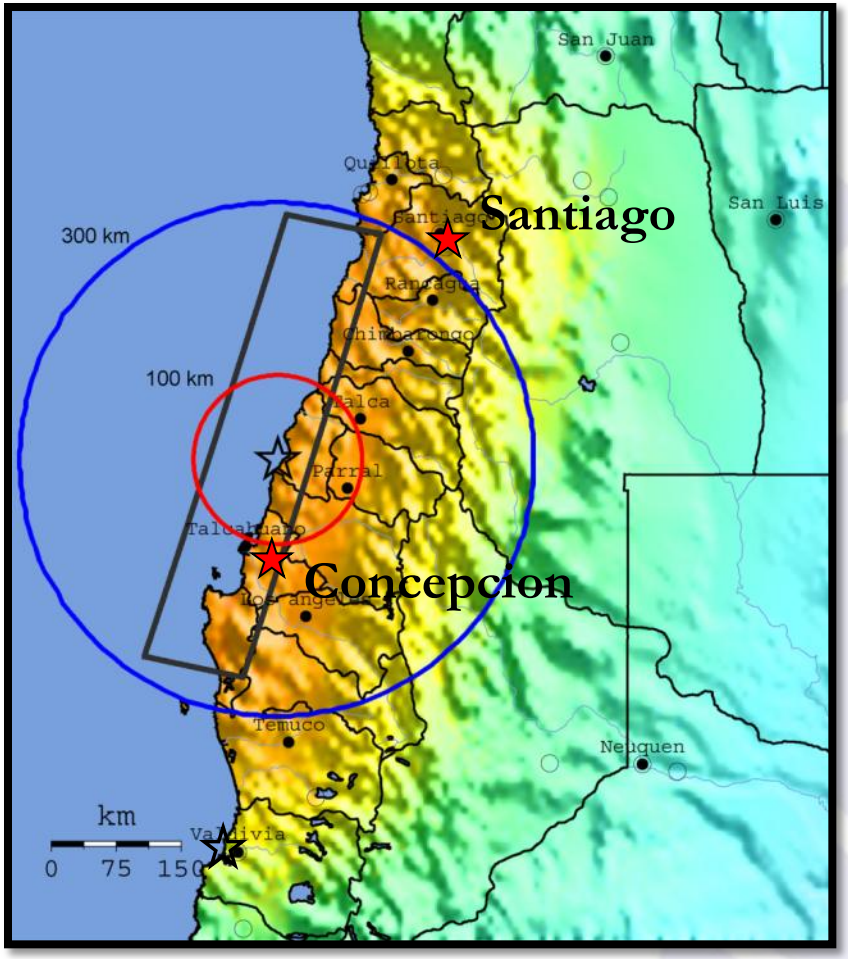
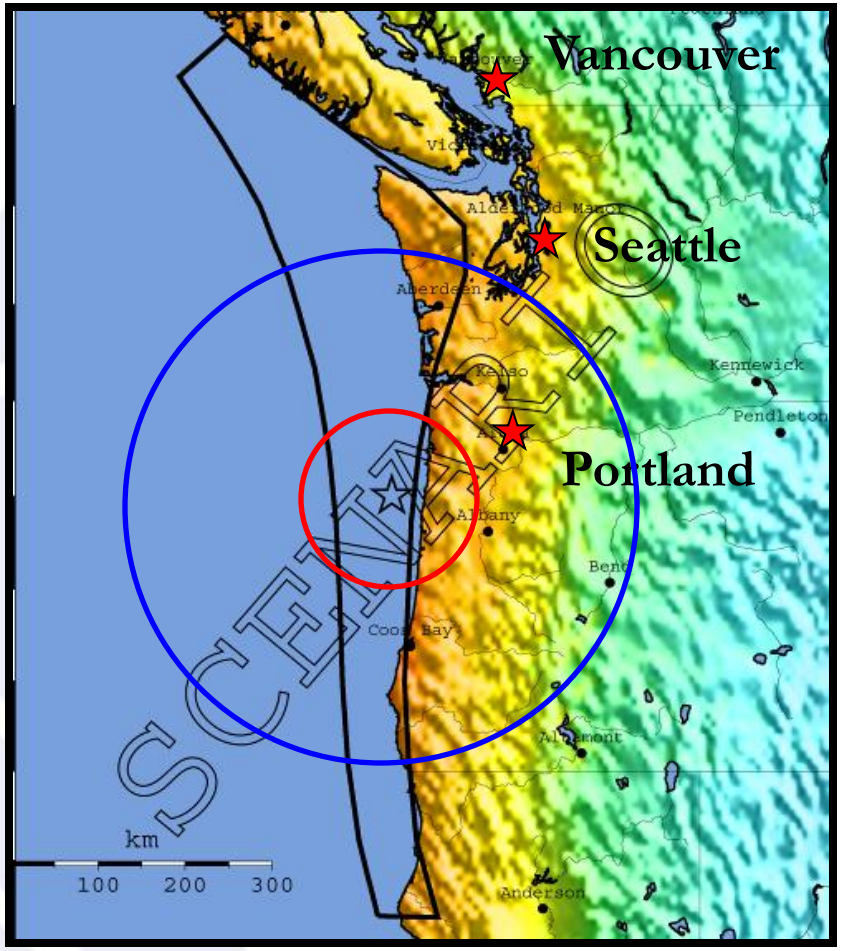
Recent Earthquakes



Chile M8.8



PNW—M9.0 Scenario



Source: USGS

See: http://www.crew.org/papers/CREWCascadiaFinal.pdf

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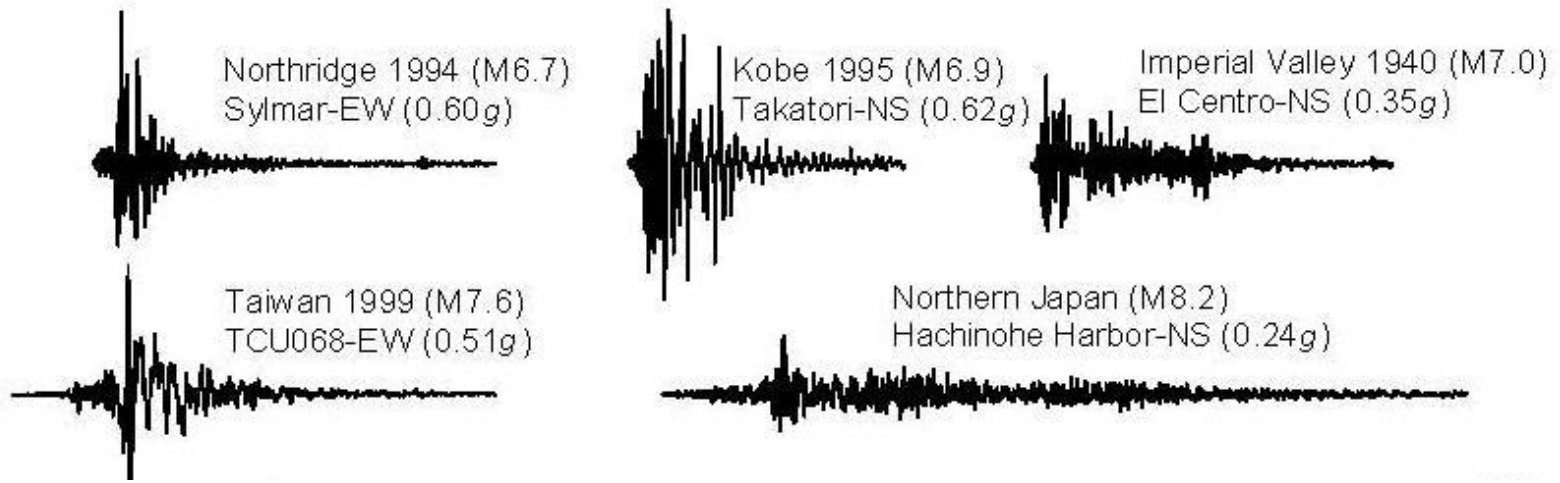
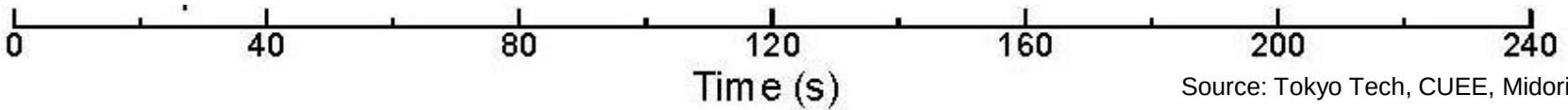
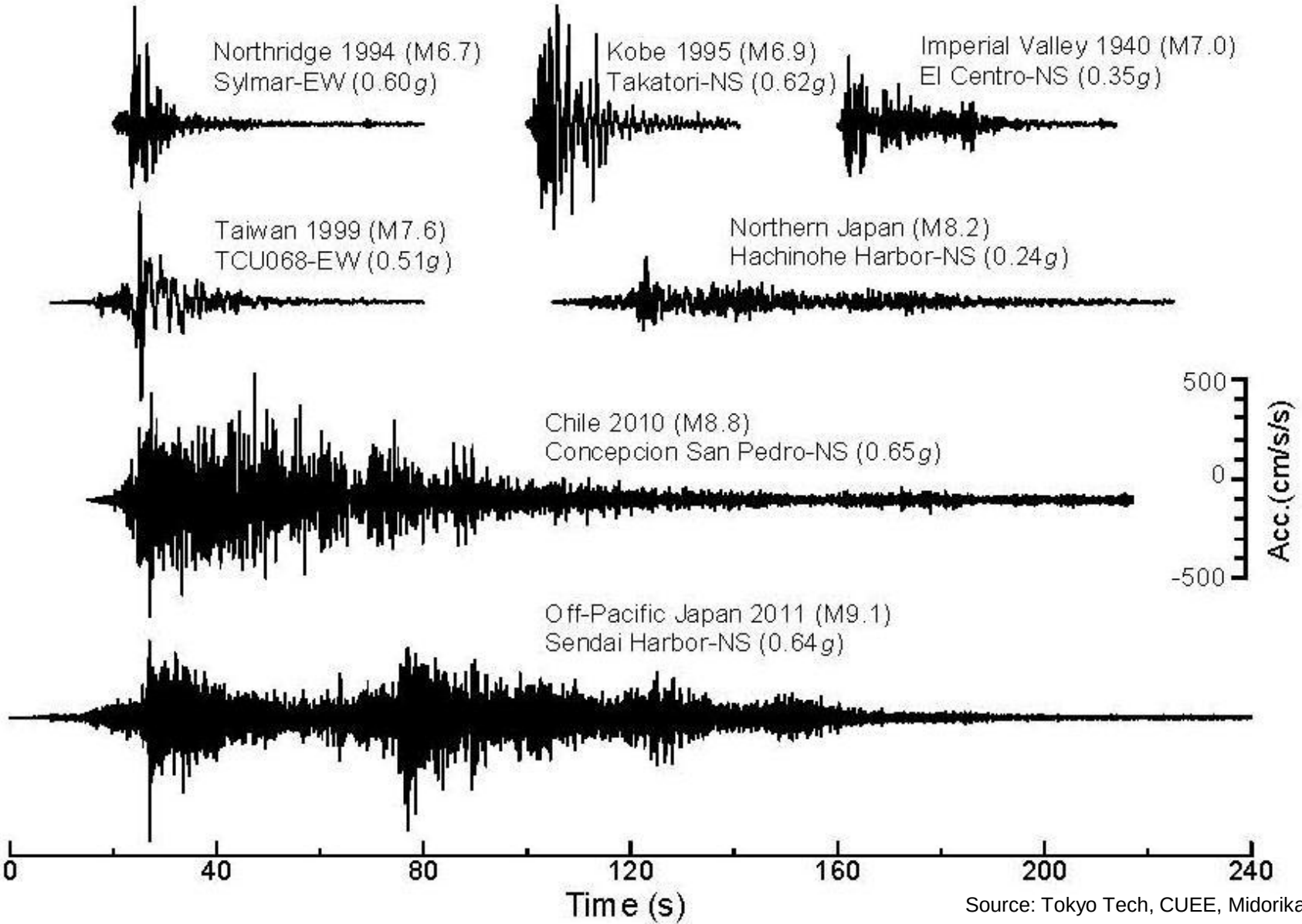
Earthquake Records Compared





Source: Tokyo Tech, CUEE, Midorikawa Lab.

Earthquake Records Compared



Source: Tokyo Tech, CUEE, Midorikawa Lab.

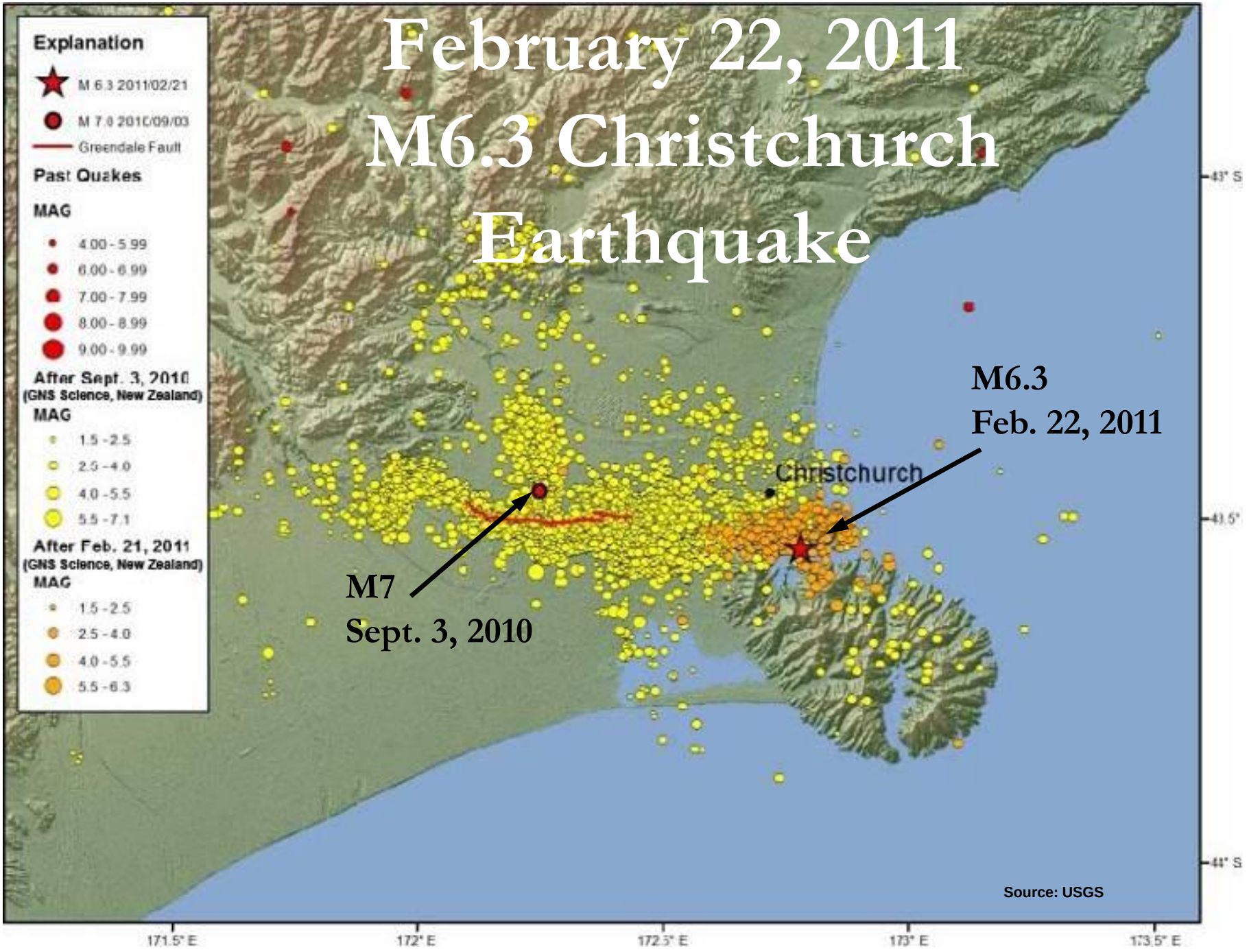
Santiago International Airport: Terminal Damage

Source: Santiago Airport

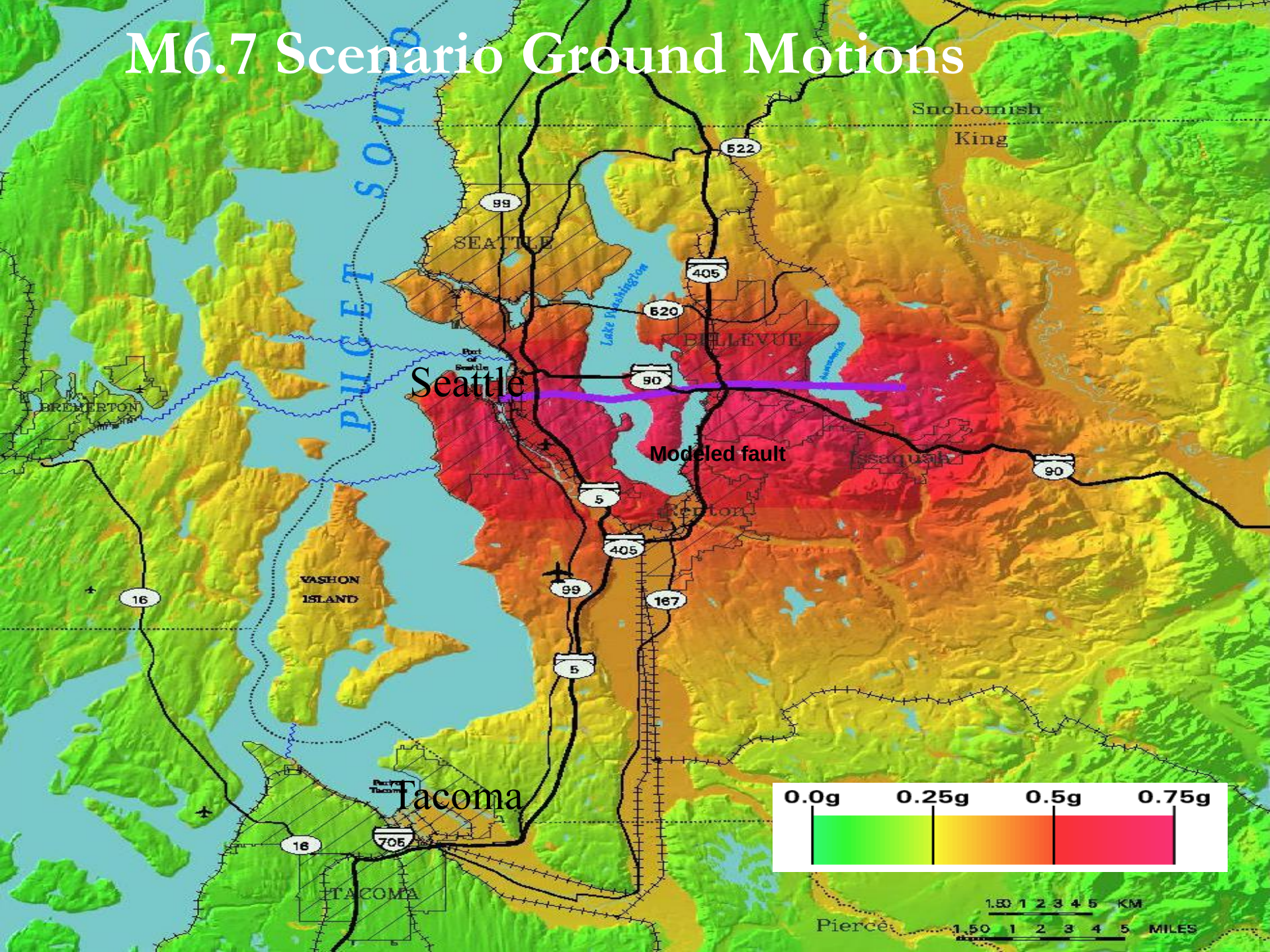
Source: Santiago Airport

Ciudad Empresarial Mid-Rise Office Park

Santiago, Chile
High-Rise
Residential Towers


February 22, 2011
M6.3 Christchurch
Earthquake
Explanation
M 6.3 2011/02/21
M 7.0 2010/09/03
Greendale Fault
Past Quakes
MAG
4.00 - 5.99
6.00 - 6.99
7.00 - 7.99
8.00 - 8.99
9.00 - 9.99
After Sept. 3, 2010
(GNS Science, New Zealand)
MAG
1.5 - 2.5
2.5 - 4.0
4.0 - 5.5
5.5 - 7.1
After Feb. 21, 2011
(GNS Science, New Zealand)
MAG
1.5 - 2.5
2.5 - 4.0
4.0 - 5.5
5.5 - 6.3
M6.3
Feb. 22, 2011
Christchurch
M7
Sept. 3, 2010
Source: USGS
43° S
43.5°
44° S
171.5° E
172° E
172.5° E
173° E
173.5° E

M6.7 Scenario Ground Motions



Source: Charlene Hails (MRP Engineering) ASCE-sponsored recon mission

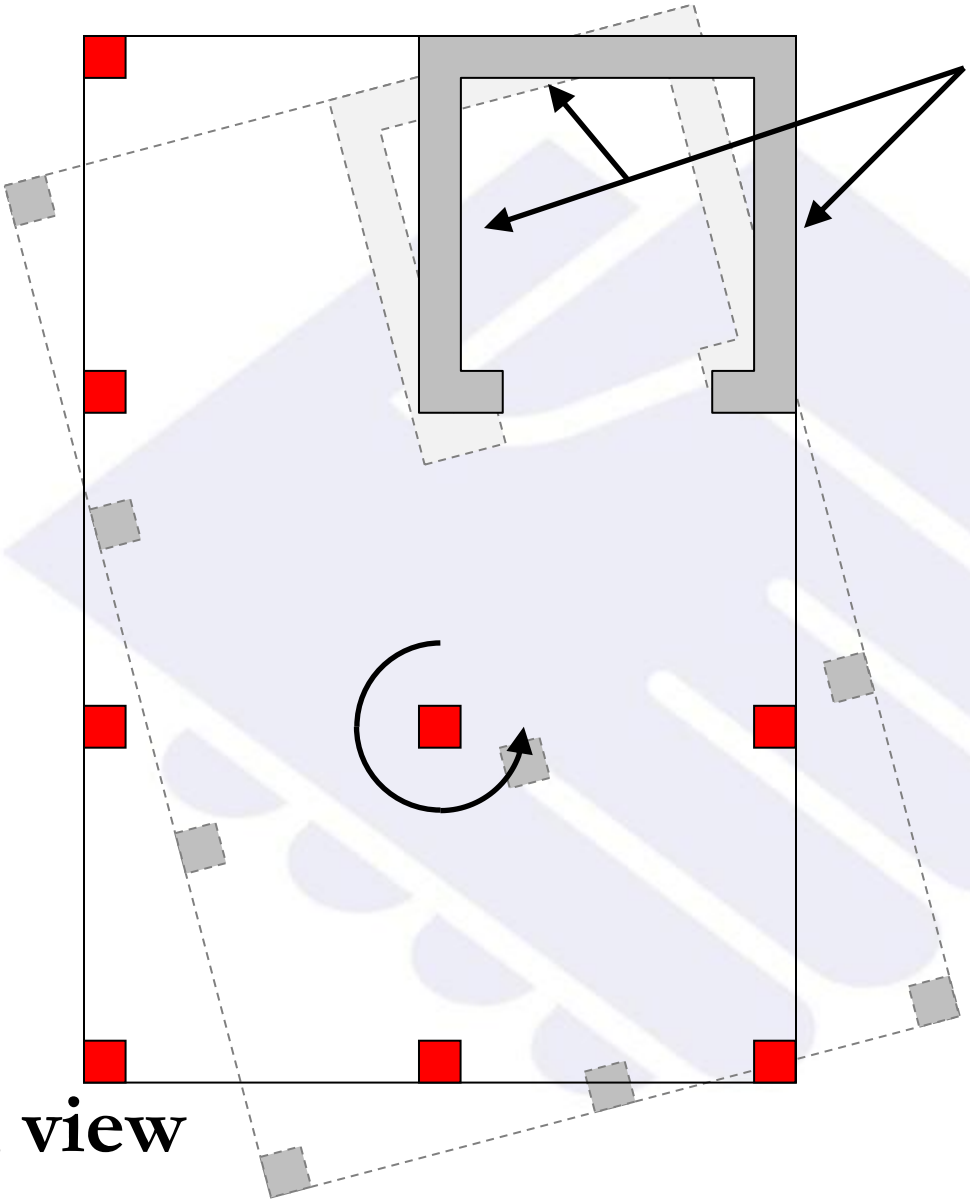
Damaged URM heritage structure

Source: Charlene Hails (MRP Engineering) ASCE-sponsored recon mission

Retrofitted URM building damage

Source: Charlene Hails (MRP Engineering) ASCE-sponsored recon mission

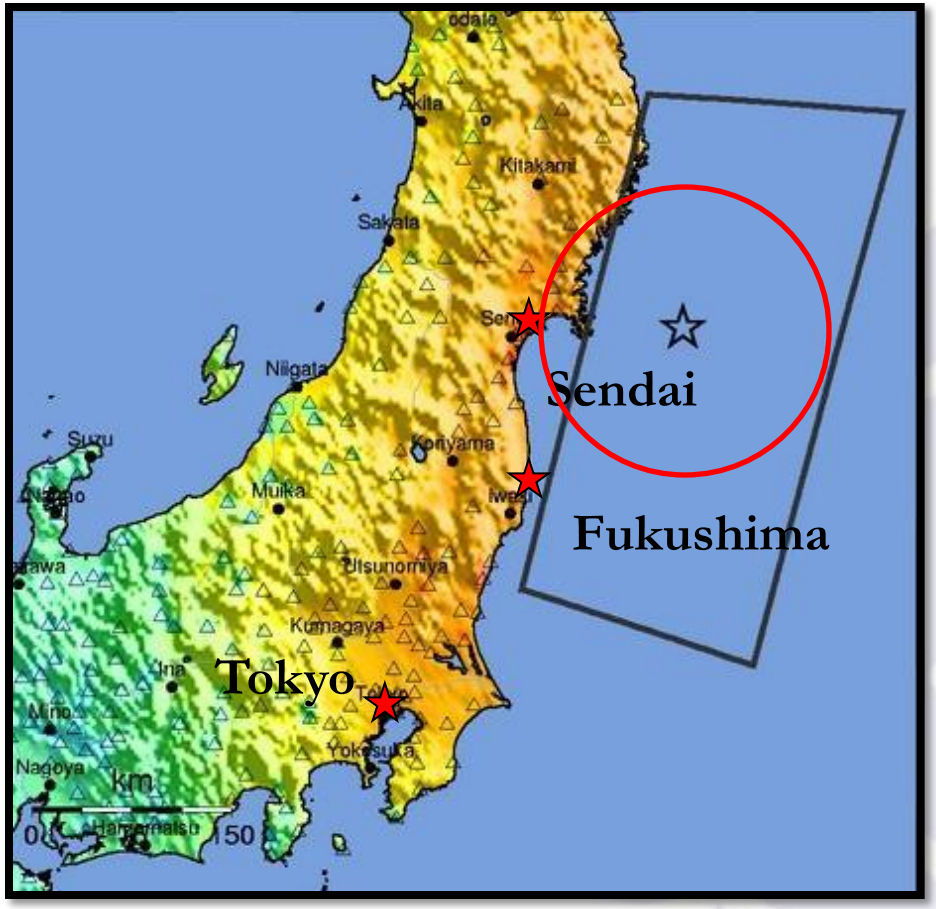
Torsion

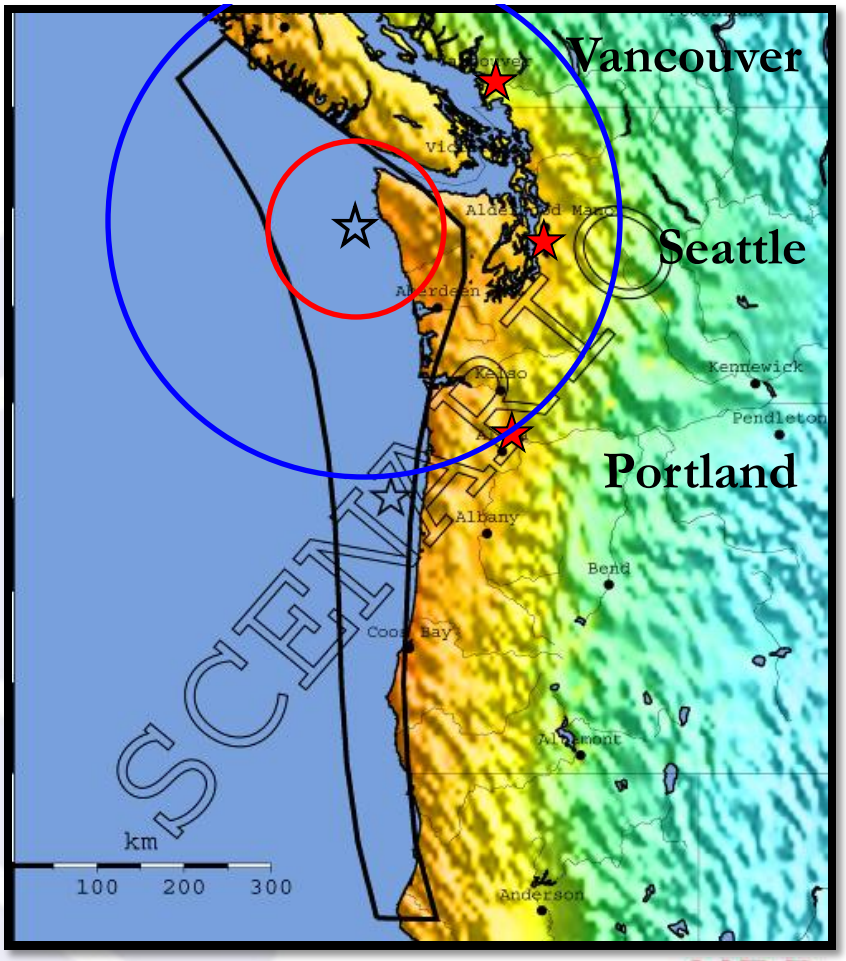


Plan view

Tohoku M9.0

PNW: M9.0 Scenario





Stronger shaking →

Source: USGS

Early warning systems

Protective Systems

Base isolation

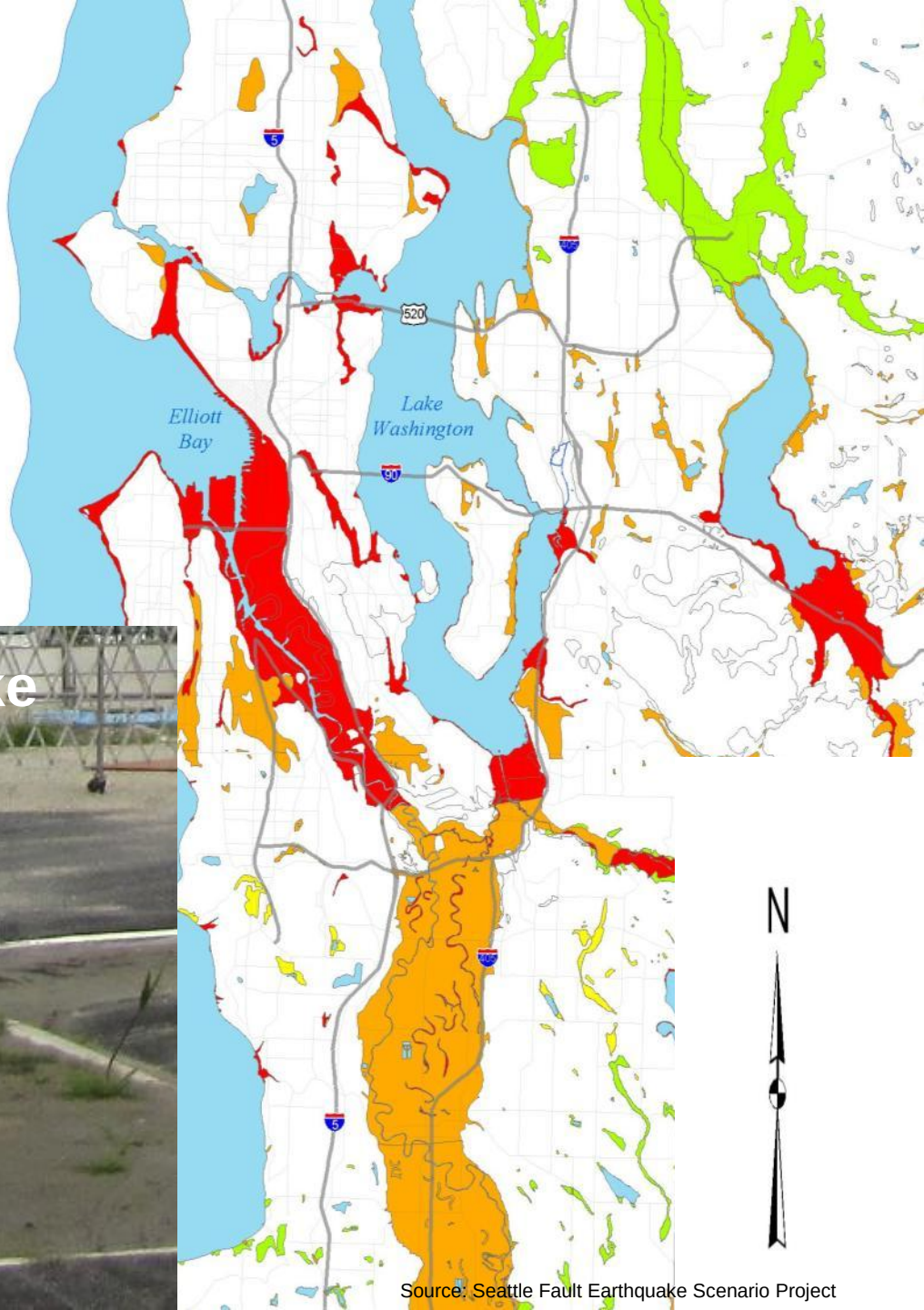
Retrofitted hospitals (and schools)

Lessons Re-learned


Tokyo area
soil liquefaction

Seattle Liquefaction Risk

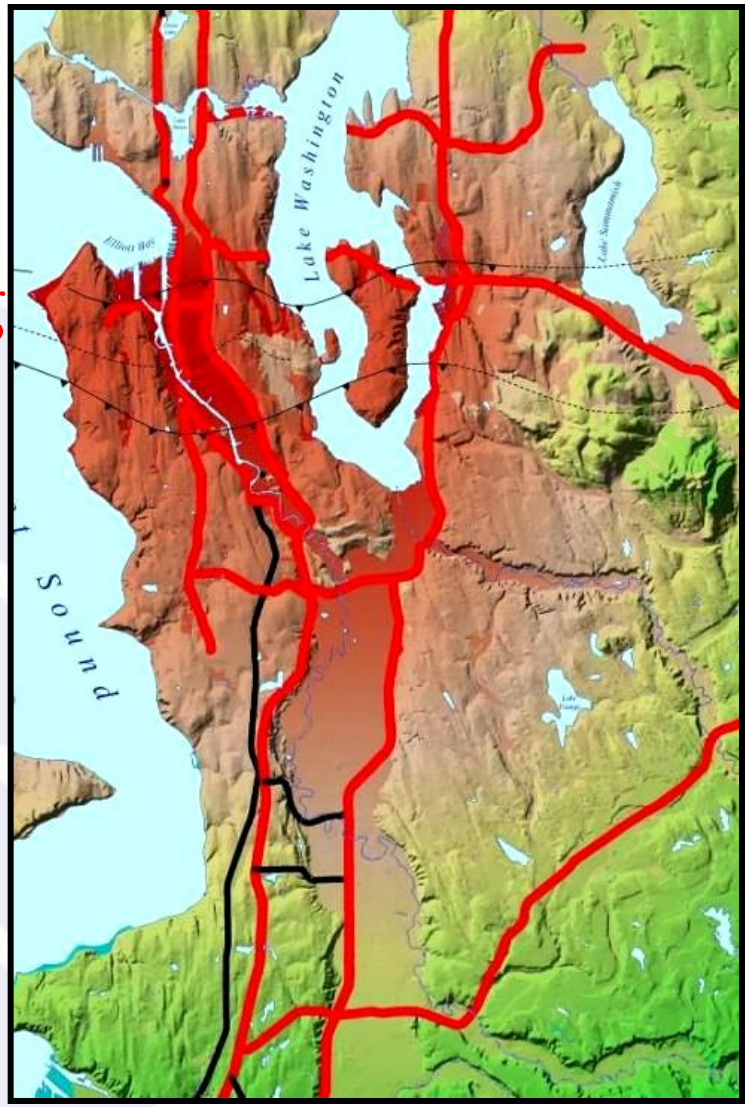
- High
- Moderate to High
- Moderate
- Low to Moderate
- Low



Source: Seattle Fault Earthquake Scenario Project

M6.7 Seattle Scenario

- http://seattlescenario.eeri.org
- 1,600 deaths; 24,000 injured
- Buildings destroyed: 9,700
- Buildings, unsafe: > 29,000
- Transportation: restricted
- Fires: 130
- Economic loss: $33 billion
- Recovery period: years



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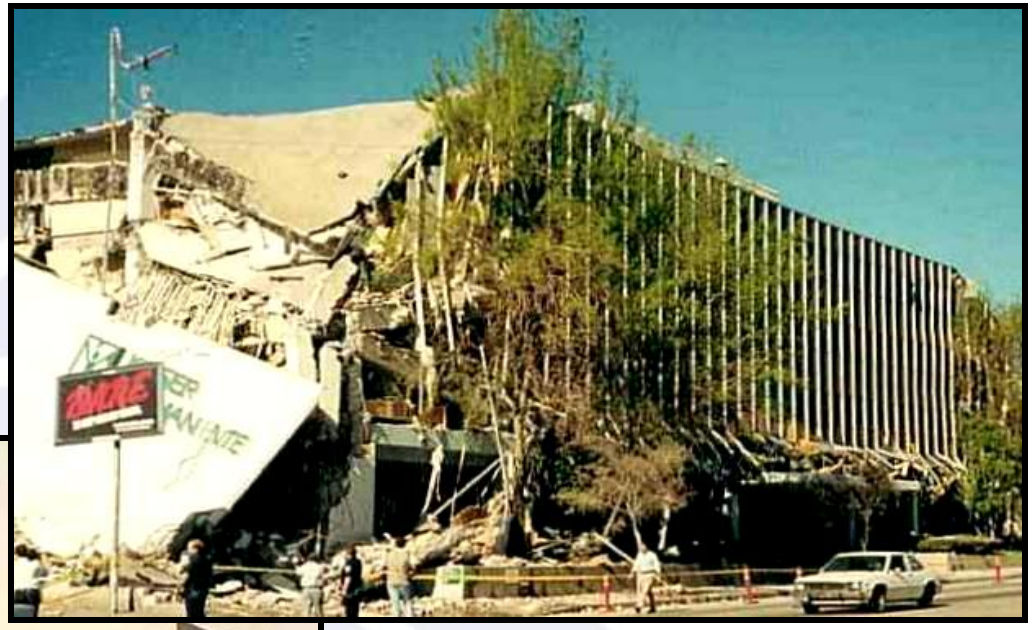
What Structures Are Most Vulnerable?

Reinforced concrete frames



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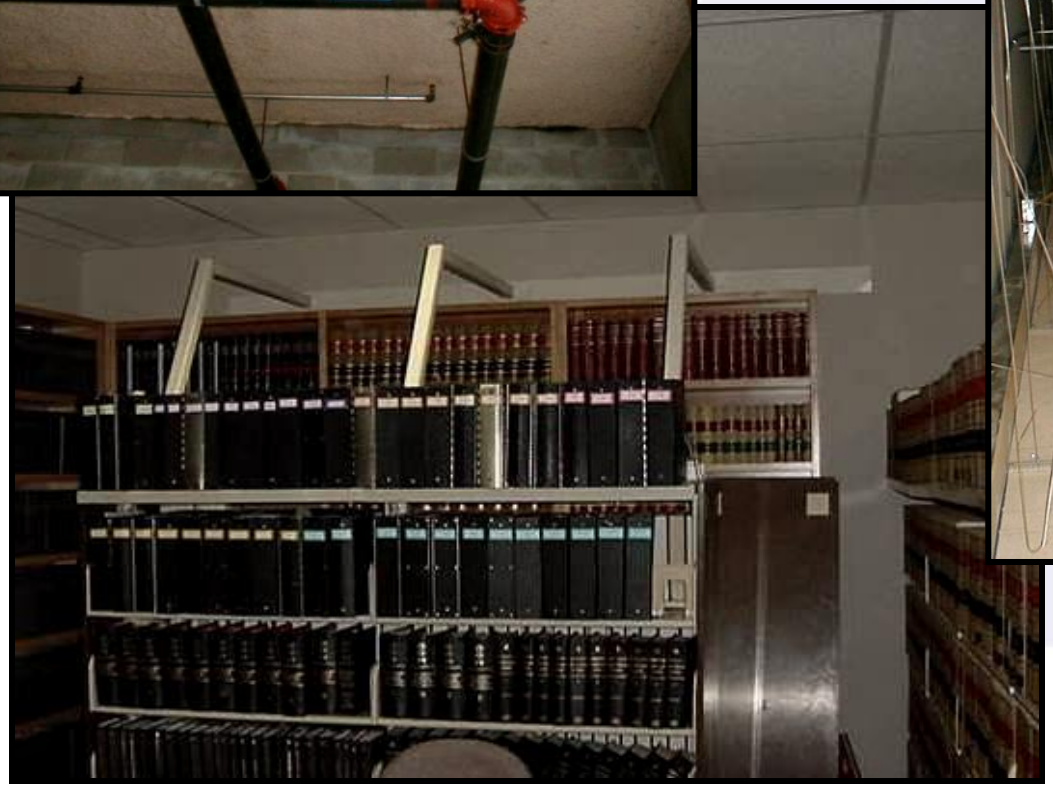
What Structures Are Most Vulnerable?

Pre-1970 Tilt Ups

Unreinforced Masonry

How to Increase Resilience?



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Public Awareness in Japan